

Nitrogen fertilization and grain protein content in California wheat

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Summary

In order to produce high quality wheat consistently and economically, growers need to be able to determine: (1) if anthesis-time nitrogen fertilization is needed to reach the target (13%) grain protein level and, if so, (2) how much nitrogen must be applied. The overall goal of this two-year project, therefore, is to identify, based on the nitrogen status and yield potential of the crop at anthesis, the nitrogen fertilization rate that will result in a grain protein content of 13% (price premium triggering level). Experiments have been designed, and are being carried out according to plan, to measure the response of grain protein content to different rates (0 to 60 lb nitrogen/acre) of anthesis-time nitrogen fertilization under different pre-anthesis nitrogen management practices (thus different yield potentials). Efficacy of broadcast vs. foliar-applied nitrogen also is being compared.

The project is being managed within the framework of the UC Statewide Small Grain Evaluation program led by Project Leader, Lee Jackson, Extension Agronomist and Statewide Cereal Specialist. Experimental sites are among those used in the UC Regional Cereal Testing Program. For the 1999/2000 and the 2000/2001 seasons, three sites were established in the Sacramento Valley using the common wheat cultivar "Kern" and three sites were established in the San Joaquin Valley using the durum wheat cultivar "Kronos". The sites in the Sacramento Valley are the Chico State University farm in Chico (Butte County), the Erdman ranch near Grimes (Colusa County), and the UC Davis Agronomy Farm. The sites in the San Joaquin Valley are the Dupont Research Farm (Madera County), the J.G Boswell farm in Corcoran (Kings

County), and the J.G Boswell Kern Lake Ranch (Kern County). University of California Cooperative Extension Farm Advisors Cass Mutters (Butte Co.), Doug Munier (Glenn Co.), Jerry Schmierer (Colusa Co.), Ron Vargas (Madera Co.), Steve Wright (Tulare/Kings Co.), and Brian Marsh (Kern Co.) were responsible for arranging for use of grower fields in their counties, working with and advising the growers on field management operations, and assisting in the application of anthesis-time nitrogen, collection of biomass samples and tissue samples for nitrogen determination, and plot harvest. Project Leader Lee Jackson's Staff Research Associate Ray Wennig (1999/2000, resigned in August, 2000) and Steve Scardaci (replaced Ray Wennig in October, 2001, resigned in July, 2001) coordinated the sowing of the experiments, collection of soil samples, application of anthesis-time nitrogen treatments, collection of biomass and tissue samples, flag-leaf chlorophyll meter readings, harvest of the plots, and initial data analysis. Tissue and grain samples were submitted to the UC DANR Diagnostic Lab for determination of nitrogen content.

Plots (each 25' x 12') were sown in the fall of 1999 and 2000, at each site using Randomized Complete Block designs with four replications. Composite soil samples (0-12" depth) were taken at each site at the time of sowing and also just prior to the application of anthesis-nitrogen to provide information on the differing N-status of each site. Crop management through anthesis followed accepted grower practices at each site, thus providing differing crop biomass and nitrogen status environments. Variable rates of nitrogen (0, 30, and 60 lb nitrogen/acre as ammonium nitrate and 30 lb nitrogen/acre as foliar-applied urea) were applied at anthesis and followed with an irrigation. Crop biomass and nitrogen content of specific tissues (flag-leaf and uppermost stem internode) were measured at the time of anthesis-applied nitrogen, 14 days post-anthesis, and at harvest. Crop biomass samples at each sampling date consisted of plants from 1-meter row/plot cut at the ground level. Subsamples of flag leaves and uppermost stem internodes were drawn from the biomass samples for total tissue nitrogen determination.

Sample collection for the 2000/2001 season and n-tissue analysis of anthesis-time and 14-days post-anthesis time flag-leaf samples and anthesis-time uppermost stem internode samples were completed at the time of this interim report. Harvest-time tissue samples have been collected and grain yields have been determined, but data have not yet been analyzed (grain harvest was not completed until July 10, 2001). Soil samples (Table 1) collected at planting time and again just before the application of anthesis-time nitrogen treatments revealed differences among sites in $\text{NH}_4\text{-N}$ and $\text{NO}_3\text{-N}$ at both sampling times. Soil texture differences and differences in P, K, and organic matter were also revealed, indicating different N-supplying environments. Flag leaf N-content at anthesis ranged from 2.94 to 3.40% at Butte, from 3.25 to 3.58% at Colusa, from 3.54 to 3.60% at Davis, from 3.48 to 3.62% at Kern, from 3.40% to 3.70% at Kings, and from 4.08 to 4.36% at Madera. Flag leaf N-content at 14 days post-anthesis ranged from 2.88 to 3.36% at Butte, from 2.51 to 3.01% at Colusa, from 3.35 to 3.59% at Davis, from 2.25 to 2.54% at Kern, from 2.71 to 3.14% at Kings, and from 3.10 to 3.86% at Madera. Flag leaf color was measured with a chlorophyll meter for later correlation with leaf nitrogen content. Stem (upper most stem internode) N-content at anthesis ranged from 1.34 to 1.52% at Butte, from 1.26 to 1.33% at Colusa, from 1.51 to 1.55% at Davis, from 1.30 to 1.36% at Kern, from 1.43 to 1.52% at Kings, and from 1.52 to 1.65% at

Madera. Grain yield, grain nitrogen content, bushel weight, kernel weight and harvest index data are being processed at the time of this interim report. Crop biomass samples will be partitioned into straw and grain for harvest index determination.

Outreach activities in the form of field meetings and workgroup discussions were conducted to extend information on the costs and benefits associated with anthesis-time nitrogen management for grain protein improvement in wheat to growers, farm advisors and other interested parties. For the 2000/2001 season Project Leader Lee Jackson discussed the project's goals and progress at the Kings County Cereal Field Day at the Kings site (on April 23, 2001) and at the Annual Small Grain and Alfalfa Field Day at UC Davis (on May 16, 2001). Attendance at the Kings County Cereal Field Day was about 30 growers, PCA's, and students of Steve Wright's Fresno State University agronomy class. Attendance at the Annual Small Grain and Alfalfa Field Day at UC Davis was about 80 (growers, seed producers, grain industry personnel, farm advisors, PCA's, UC and USDA researchers, etc.). Further discussions are planned for the training meetings for Sacramento Valley and San Joaquin Valley farm advisors with responsibility for small grains that will be held in September and October.